causing a marked proximal migration of the granules. These findings are thus in accord with those of Fujita and Bigney in their work upon the frog, and opposed to those of Klett, also upon the frog.

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Bigney, A. J., 1919. "The Effect of Adrenin on the Pigment Migration in the Melanophores of the Skin and in the Pigment Cells of the Retina of the Frog." *J. Exp. Zoöl.*, **27** (391–396).

Fujita, H., 1911. "Pigmentbewegung und Zapfenkontraktion im Dunkelauge des Frosches bei Einwirkung verschiedener Reize." *Arch. vergl. Ophthalm.*, Jahrg. **2** (164–179).

Klett, 1908. "Zur Beeinflussung der phototropen Epithelreaktion in der Froschretina durch Adrenalin." *Arch. Anat. Physiol.*, Jahrg., 1908, *Physiol. Abt., Suppl. Bd.* (213–218).

[1] Arey ('16) used the terms *distal* and *proximal* to designate the migration of the pigment granules away from the center of the melanophore cell and toward that center respectively. Hence a proximal migration would bring about what is ordinarily called the contracted condition of the melanophore and a distal migration the expanded condition.

A SIDE LINE IN THE IMPORTATION OF INSECT PARASITES OF INJURIOUS INSECTS FROM ONE COUNTRY TO ANOTHER

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Since the extraordinary initial success of the Department of Agriculture in importing the Australian ladybird beetle (*Novius cardinalis*) into California to destroy the fluted scale in the eighties, a great deal of successful work of the same sort has been done in different parts of the world. Most of these attempts have been made in a haphazard sort of way and a number of them have succeeded to a notable degree in spite of the rather unscientific way in which the importations were made and the lack of competent scientific study before the importations were attempted. The one thing which seems to have been rather carefully guarded from the start is the possibility of importing secondary parasites which might destroy the desirable assisted immigrants. Until recently there have seemed to be no time and no especial necessity for a careful biological study of the imported parasites before the importation has been attempted. Now in many cases such preliminary studies seem to be very necessary and they are being made.

One point which has undoubtedly resulted in the non-establishment of imported species has been the fact that in their native homes they had alternate hosts, feeding during one generation upon one species and during another generation upon another. Frequently the alternate host or a vicarious species has not existed in the country into which the parasites have been introduced.

On the other hand, such secondary and supplementary hosts have in a number of cases existed there, and as a result the establishment of the imported species was not only rendered more certain but the species has acted in a most beneficial way by destroying other pests, some of them in fact being native to the country into which the imported parasite was brought.

It is this side line in such importations upon which I wish to dwell for a moment in this paper.

Parasite introduction has never been attempted in any part of the world on so large a scale as it has been in this country since 1905 in the effort to secure the European and Japanese parasites and natural enemies of the gipsy moth and the European enemies of the brown-tail moth. In this work, although more than thirty species have been imported, not more than seven or eight have become established. Lack of secondary hosts may have been the cause of the failure of many of them, or there may have been other causes. An attempt is being made at the present time to determine these causes, and for the first time since the world war experts from the Bureau of Entomology are now in Europe and Japan studying the native parasites of the gipsy moth and endeavoring to send over new supplies of those species which previously failed of establishment and at the same time to secure additional species which we had not found before the war.

But the value of the comparatively few species that have actually become a part of the insect fauna of the United States as the result of the earlier introductions has been very considerably enhanced from the fact that some of them have taken readily to other imported or native caterpillars which destroy American trees and crops. The following table indicates the present situation with regard to four of these species.

HYMENOPTEROUS PARASITES

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
Euproctis chrysorrhoea L.	*Apanteles lacteicolor* Vier.	*Datana ministra* Drury	Rare
	Apanteles lacteicolor Vier.	*Hyphantria textor* Harris	Rare
	Apanteles lacteicolor Vier.	*Apatela hasta* Guenée	Rare
	Apanteles lacteicolor Vier.	*Schizura unicornis* S. & A.	Only in the laboratory, but here readily attacked
Euproctis chrysorrhoea L.	*Meteorus versicolor* Wesm.	*Hemerocampa leucostigma* S. & A.	Rare
	Meteorus versicolor Wesm.	*Hyphantria textor* Harris	Rare
Porthetria dispar L.	*Apanteles melanoscelus* Ratz.	*Hemerocampa leucostigma* S. & A.	Apparently abundant

DIPTEROUS PARASITES

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
Porthetria dispar L., and *Euproctis chrysorrhoea* L.	**Compsilura concinnata* Meig.	*Stilpnotia salicis* L.	Common and important
	**Compsilura concinnata* Meig.	*Basilarchia archippus* Cramer	Common and important
	**Compsilura concinnata* Meig.	*Euvanessa antiopa* L.	Common and important
	**Compsilura concinnata* Meig.	*Vanessa atalanta* L.	Common and important
	**Compsilura concinnata* Meig.	*Aglais milberti* God.	Common and important
	**Compsilura concinnata* Meig.	*Diacrisia virginica* Fab.	Common and important
	**Compsilura concinnata* Meig.	*Datana ministra* Drury	Common and important
	**Compsilura concinnata* Meig.	*Euchaetias egle* Drury	Common and important
	**Compsilura concinnata* Meig.	*Estigmene acraea* Drury	Common and important
	**Compsilura concinnata* Meig.	*Hemerocampaleucostigma* S. & A.	Common and important
	**Compsilura concinnata* Meig.	*Cirphis unipuncta* Haw.	Common and important
	**Compsilura concinnata* Meig.	*Papilio polyxenes* L.	Common and important
	**Compsilura concinnata* Meig.	*Papilio turnus* L.	Common and important
	**Compsilura concinnata* Meig.	*Anosia plexippus* L.	Common and important
	**Compsilura concinnata* Meig.	*Apatela hasta* Guenée	Common and important
Porthetria dispar L., and *Euproctis chrysorrhoea* L.	**Compsilura concinnata* Meig.	*Apatela brumosa* Guenée	Common and important
	**Compsilura concinnata* Meig.	*Schizura concinna* S. & A.	Common and important
	**Compsilura concinnata* Meig.	*Polygonia interrogationis* Fab.	Common and important
	**Compsilura concinnata* Meig.	*Papilio troilus* L.	Common and important
	**Compsilura concinnata* Meig.	*Alypia octomaculata* Fab.	Common and important
	**Compsilura concinnata* Meig.	*Epargyreus tityrus* Fab.	Common and important
	**Compsilura concinnata* Meig.	*Mamestra adjuncta* Boisd.	Apparently important

*Besides the above listed hosts we have reared *Compsilura* from about 60 other species of native larvae. We also have records of several more species reared by others.

DIPTEROUS PARASITES (Cont'd)

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
	**Compsilura concinnata* Meig.	*Notolophus antiqua* L.	Apparently important
		Croesus latitarsus Nort.	Apparently important
	**Compsilura concinnata* Meig.	*Phlegethontius quinquemaculata* Haw.	Apparently important
		Pontia rapae L.	Apparently important
	**Compsilura concinnata* Meig.	*Malacosoma americana* Fab.	Rare
	**Compsilura concinnata* Meig.	*Malacosoma disstria* Hübn.	Rare
	**Compsilura concinnata* Meig.	*Hyphantria textor* Harris	Rare
	**Compsilura concinnata* Meig.	*Mamestra picta* Grote	Rare
	**Compsilura concinnata* Meig.	*Halisidota caryae* Harris	Rare
	**Compsilura concinnata* Meig.	*Halisidota tessellaris* S. & A.	Rare
Porthetria dispar L., and *Euproctis chrysorrhoea* L.	**Compsilura concinnata* Meig.	*Melalopha inclusa* Hübn.	Rare

PREDATORS

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
Porthetria dispar L., and *Euproctis chrysorrhoea* L.	*Calosoma sycophanta* L.	*Porthetria dispar* L.	Abundant in sections of New England where oak trees abound that are heavily infested with this host. *Important enemy*
	Calosoma sycophanta L.	*Euproctis chrysorrhoea* L.	Common
	Calosoma sycophanta L.	*Stilpnotia salicis* L.	Apparently important
	Calosoma sycophanta L.	*Heterocampa guttivitta* Walk.	Rare
	Calosoma sycophanta L.	*Hemerocampa leucostigma* S. & A.	Rare
	Calosoma sycophanta L.	*Ennomos subsignarius* Hübn.	Common
	Calosoma sycophanta L.	Noctuid sp. (Tree climbing larvae.)	Common

PREDATORS (Cont'd)

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
	Calosoma sycophanta L.	*Malacosoma americana* Fab.	Rare
	Calosoma sycophanta L.	*Malacosoma disstria* Hübn.	Common
	Calosoma sycophanta L.	*Geometrid* sp.	Common

This predator does not refuse or hesitate to attack any species of Lepidopterous larvae ordinarily met on tree growth during the summer months at the time of its abundance; hence there are many other species that fall prey to it, the names of which are not yet recorded. Several species of Lepidopterous larvae have been offered as food to the beetles in jars and cages which were readily consumed by them but are not recorded above.

PREDATORS (Cont'd)

HOST FOR WHICH IMPORTED	NAME OF PARASITE	AMERICAN SPECIES ATTACKED	COMMENT ON ABUNDANCE
Porthetria dispar L., and *Euproctis chrysorrhoea* L.	*Carabus auratus* L.	Gray field slug (*Agriolimax agrestis* L.)	Apparently important
	Carabus auratus L.	Noctuid sp. (Ground cutworms)	Apparently important

This Carabid undoubtedly devours other species of soft-bodied insects ordinarily found in or near the ground.

Of these, it will be seen that the Tachinid fly *Compsilura concinnata* has readily accommodated itself to a number of native injurious species and that it is an introduction which is of great importance entirely aside from its efficiency as a parasite of the brown-tail moth.

It seems reasonably certain also that the little Braconid *Apanteles lacteicolor* is a species which will prove to have a very broad value. In addition to the records already given, I am informed by Mr. R. T. Webber of the Gipsy Moth Laboratory that the Tachinid mentioned is also probably a parasite on the larva of *Cimbex americana* (a sawfly) and on two other, unidentified sawflies; while Mr. C. W. Johnson, Curator of the Boston Society of Natural History, has noted an apparent parasitism of this species on the pine weevil (*Pissodes strobi*).

A most useful feature in the biology of the Tachinid fly is that with the larger caterpillar hosts the third stage of growth is the one in which they are nearly always attacked, which allows their Microgaster parasites to develop and emerge without having to struggle against a simultaneous parasitism by the Tachinid.

Moreover, this important imported Tachinid has not only spread all

over the whole gipsy moth territory in the United States but is found in some cases twenty miles beyond the line of gipsy moth spread.

I confess that I anticipate great benefits in this same broad way from *Apanteles lacteicolor* since it apparently attacks not only hairy caterpillars but naked caterpillars.

Of late the Bureau of Entomology has been introducing from south Europe the parasites of the imported European corn borer. Although it is too early to state positively that any of these imported parasites have been established, an important parasite known as *Habrobracon brevicornis*, found last summer in a region of south France near Hyères, has been brought over in very considerable numbers and has been reared in the laboratory with the utmost ease and some thousands have been liberated. It manages to lay its eggs in the larva of the borer while in the cornstalk, and, as it happens that we have a native cornstalk borer which is especially prevalent in the southeastern United States, we have experimented in the laboratory at Arlington, Massachusetts, with the latter species, and find that the European parasite takes to it readily and should become, if we can establish it, an important parasite of the southern corn pest. This work was done on the initiative of and under the direction of Mr. W. R. Walton.

Further than this, there exists a Lepidopterous borer in the sugar cane in Louisiana which is closely allied to the corn stalk-borer of the southern States and which will with little question be parasitized by this European parasite when they are once brought together. Inasmuch as the Habrobracon normally inhabits the Mediterranean littoral, it is altogether likely that it will accommodate itself to the climate of the Gulf of Mexico littoral more readily than it will the harsher climate of New England and New York. The experiment has actually been begun and it is found that the European parasite breeds freely in confinement at New Orleans on the sugar-cane borer. It is planned to liberate large numbers the present season on an isolated infested plantation in Louisana. We have strong hopes of its successful establishment.

The evolution of parasitism with insects is an interesting study. As in so many other directions in biological studies, we can trace the course of probable evolution by different stages which exist at the present time. The very catholic methods of the Tachinid fly listed above, which lays its eggs not only on all sorts of caterpillars, whether hairy or naked or large or small, but will even oviposit on the caterpillar-like sawfly larvae, and even upon a weevil grub in one instance (not, however, as yet fully verified), indicate rather surely that the parasitic habit has more recently become adopted with the Tachinids than with very many of the parasitic Hymenoptera.

But with the Hymenoptera we have all stages in the evolution, from

general parasitism to a highly specific parasitism, in the latter cases the parasite having become so perfectly modified to fit itself to the one species of host that it must mean an advanced stage of evolution.

In considering the importation of parasite species we must aim to have both kinds if they exist—the specifically constituted parasites and the general parasites. From the ranks of the latter we will have great help in the destruction of large numbers of the particular insect against which it was imported, but it will have the additional advantage of accommodating itself to other injurious species, and hence on the whole will probably be a more desirable addition to the American parasite fauna.

Although not parasites, mention should be made of two species of ground-beetles brought over from Europe in the course of the gipsy moth work. *Calosoma sycophanta* has been found to attack a number of injurious native caterpillars; and *Carabus auratus*, while probably primarily a feeder upon slugs, as it is in its native home, also feeds upon cutworms and probably other soft-bodied insects ordinarily found in or near the ground.

ON THE LOCATION OF THE ROOTS OF THE DERIVATIVE OF A POLYNOMIAL

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This note considers some geometric aspects of the problem of the approximate location of the roots of the derivative $f'(z)$ of a polynomial $f(z)$ when the roots of $f(z)$ are known. If $f(z)$ has m_1 roots in a circle C_1, m_2 roots in a circle C_2, and no other roots, the roots of $f'(z)$ are known to lie in C_1, C_2, and a certain third circle C which is readily determined.[1] Moreover, if $f(z)$ has m_1 roots in C_1, m_2 roots in C_2, m_3 roots in C_3, and no other roots, and if the circles C_1, C_2, C_3, are equal and have collinear centers, the roots of $f'(z)$ are known to lie in those circles and in two circles C', C'' equal to the original circles and whose centers are collinear with their centers.[2] In each of these cases, the actual *locus* of the roots of $f'(z)$ consists of the circles stated, when the given circles are the loci of those roots of $f(z)$ (supposed to vary independently) which they contain.

The second of these results suggests the problem of the determination of the locus of the roots of $f'(z)$ when the locus of the roots of $f(z)$ consists of three circles C_1, C_2, C_3 which are not supposed equal and with collinear centers.[3] The solution of that problem is indicated in the present note; the answer is stated in the

THEOREM. *Let circles C_1, C_2, C_3 be the respective loci of m_1, m_2, m_3 roots of a polynomial $f(z)$. Then the locus of the roots of $f'(z)$ consists of C_1, C_2,*